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ENERGIZING TOMORROW'S AGRICULTURE

New energy solutions will boost efficiency, slash costs and drive sustainable agriculture

It's an old business adage that bears repeating: "You can't manage what you don't measure." It also is the critical first step in improving energy efficiency.

"Everyone wants to cut energy use and the cost it represents," says Jason Price, project manager with Alberta Agriculture and Rural Development (ARD). "But to cut properly, you need to first have a clear knowledge of exactly where your energy is going. That means measuring at a level that goes beyond what appears on your monthly bills. You need to dig deeper to pinpoint where your energy costs are coming from."

There's a trend in agriculture toward more sophisticated assessments of energy use. The On Farm Energy Efficiency Program, developed and delivered by ARD and partners, is one example. Offered first to livestock producers in southern Alberta, the program provided a good look at effective measuring techniques, producer attitudes and the potential for energy efficiency improvements. It also set the stage for offering broader versions of the program to more producers.

The program helps producers identify ways to reduce costs quickly, says Price, who along with colleague Darryl Slingerland helped design the assessment. "One of the first things the program looks for is what we call 'low-hanging fruit' – the simple things that can be done quickly to make a big improvement. It then moves on to other options for reducing energy use that producers can implement over time. As a result, producers participating in the program have an opportunity to make big cost reductions right away and then make further reductions at a pace that makes sense for their situation."

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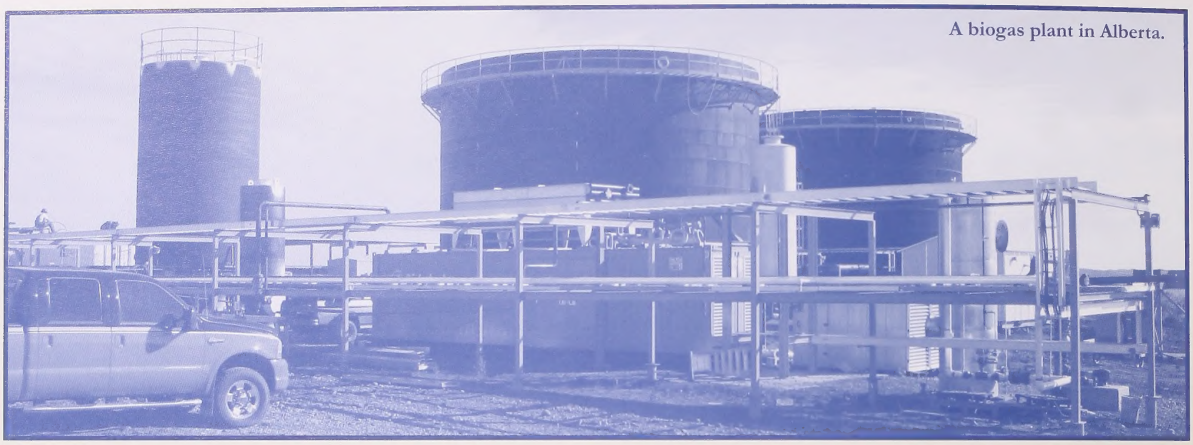
A NEW WORLD OF ENERGY

What will the energy picture for Alberta farming look like in five, 10 or 20 years? Here are several key areas of innovation and the information available to help producers make decisions.



A biogas plant in Alberta.

FARMING THE SUN

Solar thermal technology offers strong long-term investment return

Solar thermal energy is a straightforward concept. Every day the sun delivers heat that can be captured and used for space heating, water heating and electricity.

The technology. With systems used strictly for space heating, heat is transferred directly from outside to inside air using specially designed panels, windows or solar walls. These can transfer heat to the space directly beneath the envelope, or feed into a ventilation system. Heat transfer and distribution can be aided by fans in both types of systems.

Today, most heating systems of commercial scale use solar panels, which are increasingly viewed as the most straightforward and best 'bang for the buck' option. Solar walls are becoming more common in everything from hospitals and schools to residences. They have yet to catch on in agriculture, but more producers are taking a closer look and some are adopting the technology, says ARD's Jason Price.

The investment. A solar wall designed for a 400 foot long barn might cost around $35,000 to $50,000. Depending on heat costs, that could save $10,000 to $20,000 per year on heating. Once the install is paid off, the operation's source of heat is essentially free. Most thermal solar walls are good for the life of a new building.

Interest in alternative technology ebbs and flows with prices for conventional energy sources such as natural gas, says Price. A couple years back, with high natural gas prices, there was a clear spike in interest, which has now subsided a bit with those prices currently much lower.

The bottom line. The key, he says, is to think long term. "Stability itself can be a big advantage during periods of fluctuating cost," says Price. "With conventional energy prices low, the savings from solar thermal to your monthly power bill won't be dramatic, but the savings will grow when prices inevitably go back up. There's start-up cost to installing a solar thermal wall, just like there is for any other type of building material. After that, from the perspective of your monthly power bill, you're effectively locked in at a low rate for the life of your building."

ARD is involved with research designed to help pinpoint cost saving potential and payback period for livestock operations. "This study will provide baseline data that will allow for projections under a range of climate and energy price scenarios."

HARNESSING 'EARTH POWER'

Producers considering energy alternatives may find one good option right beneath their feet

Earth energy systems are known by a variety of terms including geothermal heat pump systems, geo-exchange systems and others. The defining characteristic is that these systems transfer the moderate heat from the ground to a vapour compression cycle which outputs to a distribution system in a home or facility, for use in space heating or water heating.

The technology. The term "geothermal energy" technically refers to large-scale energy transfer or generation based directly on using extreme ground heat sources such as geysers or molten rock. Earth energy systems are specifically ground-source heat pump systems that use the moderate heat available nearly everywhere under the ground.

A typical earth energy system includes three main components: ground loops of pipe, an above-surface heat pump system and a distribution system connected from the heat pump that carries the heat to hot air outlets for space heating and / or to water tanks for water heating. While in Canada the main interest in earth energy systems is for heating purposes, the heat pump on these systems can also be reversed to provide cooling, by taking heat from the building and transferring it into the ground.

The investment. The cost to design and install an earth energy system is substantial. A system for a modest size commercial facility can run from $30,000 to $70,000 or more, which is based on an estimate of approximately $2,500 per ton of heat pump capacity plus the balance of the system.

The bottom line. "The main obstacle is high start-up cost, but earth energy can be very cost effective over the longer term – it can cut annual energy bills by 50 percent," says ARD engineer Kelly Lund. "The key with earth energy systems is you are transferring and upgrading heat, not generating it. The energy itself does not need to be created and is essentially free. One factor is that earth energy systems run on electricity, so this needs to be factored in to any assessment of cost, efficiency or environmental impact."

CAPTURING WIND ENERGY

A growing force in southern Alberta

Wind power is a leading focus of alternative energy interest on the Prairies, especially in southwestern Alberta where stong winds are common.

The technology. Modern aerodynamics and engineering have improved wind turbines to the point where they can provide reliable, cost-effective, pollution-free energy for individuals and communities. It is generated from turbine systems that convert the kinetic energy of the wind into mechanical energy or electricity.

The investment. Generally, the larger the system, the lower the investment cost per kilowatt, with average total installed cost per kilowatt ranging from $3,000 to $4,000 for small scale farm installations and $6,000 to $8,000 for residential according to figures provided by the Canadian Wind Energy Association.

Lund says wind power, depending on location, can generate faster payback than other alternative energy technologies with return on investment periods of 12 to 25 years being fairly common.

The bottom line. Wind power projects often come hand-in-hand with obstacles such as the municipal permitting process, in which the concerns of neighbours have been known to put projects and access to transmission lines of sufficient capacity at risk. There's also the simple fact that there will be periods of time in which wind is not available.

"A wind resource assessment is critical before investing in a wind power project," says Lund, and that means having reliable wind measurement data available. This usually requires investment of time and money for site monitoring. "For small projects, the expense of resource monitoring can almost be as much as the cost of equipment," she says. "Consulting published data can be a good first step. You wouldn't want to base your decision on it completely, but it can give you a rough idea of whether the project is worthy of further investigation."

TAPPING MANURE ENERGY WITH BIOGAS PRODUCTION

Twin environmental and energy benefits drive interest

Biogas production is an option that is greener than any other gas technology and the concept is a good fit for a bio-based industry that generates large volumes of organic byproduct, such as manure, food and meat processing wastes and crop residues.

The technology. Biogas production is based on the naturally occurring process of "anaerobic digestion" or the breaking down of organic material in an oxygen-free environment. This process takes place in an insulated, oxygen-free tank or container called an anaerobic digester or biodigester. It's within this "no air" environment that certain bacteria and other microscopic bugs excel at the handiwork of separating biomaterial such as manure into its various components.

In the case of livestock manure, this separation process results in two components – a biogas made up primarily of methane and carbon dioxide, and a slurry called "digestate," that is much easier to handle than the original unprocessed manure.

The biogas that is released from this process is funneled out of the biodigester and stored for use as a fuel source. While some small scale systems use the biogas as is, other small systems and all large scale systems also use a purification process to improve the quality and consistency of the biogas. Biogas can be burned to produce electricity and heat, just like natural gas – either for use at an on-farm level or potentially for broader use.

There are many types of biodigesters, from simple small scale types to very large plant-scale versions, including some like the Integrated Manure Utilization System (IMUS) at Vegreville, Alta., that are part of sophisticated integrated waste management systems.

The investment. "A viable biogas production system can be costly and require careful management, so producers who are considering adopting this type of technology need to examine all aspects of it," says ARD engineer Mahendran Navaratnasamy.

For large scale systems, the main hurdle to adoption is economic feasibility, he says. The capital cost of large scale anaerobis digester plants are very high and may range up to a few million dollars depending on the size of the plant. American studies have concluded the payback period can range from five to 16 years depending on climate, feedstocks and the price of energy.

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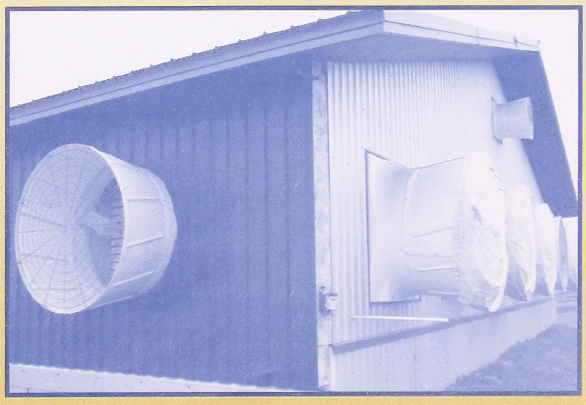
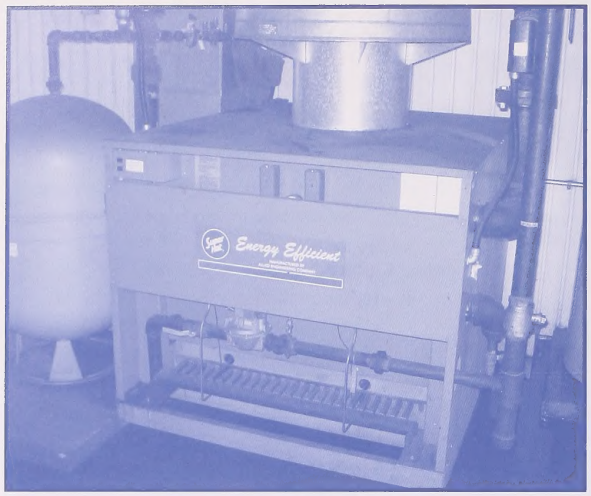


Solar energy. Solar panels are increasingly viewed as the best 'bang for the buck' option for commercial scale heating.



Energy efficiency. There are more options than ever for efficient energy technology. Consider upgrades even if your current technology still has lots of life in it.

At a small scale, there is growing adoption of so-called "lagoon digesters." These digesters, which consist simply of a sealed lagoon rather than a typical biodigester container, are attractive as a relatively low cost biogas production option, particularly for smaller operations focused primarily on the manure management benefits.

"Lagoon digesters are a good option in many cases, but consistency of energy for on-farm use can be a big issue since these systems don't provide a controlled environment to optimize year-round biogas production," he says.

The bottom line. The main drivers of the biogas opportunity for agriculture are the twin benefits of byproduct management – particularly livestock manure – and renewable energy production, says Navaratnasamy. "More producers are asking questions about biogas, and a growing number every year have taken the step of completing feasibility studies."

Because most small scale digesters aimed at on-farm energy use are geared toward using biogas to produce heat, one option to better make use of biogas in the summer is to invest in a micro-turbine to allow for conversion of biogas energy into electricity. "This is a good option that has become more economical and effective.

"At best, it's estimated that biogas from agriculture could supply maybe two to three percent of Alberta's energy needs," says Navaratnasamy. That's significant, but it's clear by far the major benefit will be from an environmental perspective.

The value of the digestate created through the anaerobic digestion process is also significant. Compared to raw manure, it is much easier to handle and use for land application, with reduced potential for surface or groundwater pollution. It also is richer in ammonium and as a result has better value as fertilizer. It also has reduced odor and less potential for carrying pathogens.

BUILDING BIOMASS COMBUSTION

Transforming crop residue into valuable, clean burning energy

In agriculture today, there is more focus than ever on looking at the productive use of by-products.

One of the most promising opportunities is to use straw and other crop residues as an energy source for heating, through the process of biomass combustion, says ARD's Kelly Lund.

The technology. The process of biomass combustion, which by definition involves burning plant-based organic material to create energy, is growing in popularity worldwide. In the case of industries such as forestry and agriculture, biomass combustion offers a way to make use of by-products or residues that might otherwise go unused or represent a significant cost to manage.

A key development driving this opportunity is technology advances – not only in combustion furnaces that can better handle crop residues, but in processing options that turn raw biomass into pellets or briquettes for use in these systems.

Using these forms of processed biomass and modern systems, producers have options to produce energy for heating their own facilities and residences or, potentially, to sell to other industries. In Canada, a leading example of the latter is in Ontario, where the greenhouse industry now uses biomass combustion of agro-pellets as its main heat source, supplied by local farmers.

The investment. "Quality biomass combustion systems are now available for a range of scales," says Lund. "With processing, agriculture can be a good producer, user and supplier of fuel for these systems."

There is a wide range in investment cost depending on scale and type of technology, she says. The best way to get information on potential cost and payback period is to contact suppliers.

The bottom line. "For on-farm use, getting into biomass combustion is a matter of investment and implementing the right approach and system for a specific operation," says Lund. "For supplying energy off site, the key is to develop markets. For larger scale opportunities like the greenhouse industry example in Ontario, there are often advantages to pursuing them at industry level. They take time and resources to develop, but can in the end can be quite profitable and offer many additional benefits."

Lund is part of an ARD team that has commissioned and provided technical oversight support to two major studies examining the opportunity for creating an ag residue-based bioheat industry in Alberta. "The findings indicated that Alberta has substantial agri-fibre biomass residue that could be used as fuel for bio-energy," says Lund. "They also showed that, with the technology improvements now coming on stream, this opportunity is much closer to reality for both producers and industry."

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